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THE

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AND

JOURNAL

OF THE

Mineralogical Society.

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EDITED BY A COMMITTEE OF COUNCIL.

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THE MINERALOGICAL SOCIETY

Mineralogical Society.

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Receipts and Payments from 1st January to 31st December, 1887.

RECEIPTS.

	£	s.	d.
Balance from year 1886			
Subscriptions in advance	8	16	6
" for current year	1	6	0
" (arrears)	76	11	0
Entrance Fees	15	4	0
Sale of Publications	4	4	0
Dividends on Stock	14	12	11
Extra Copies of Publications	5	19	8
	2	13	0
	£129	7	1

PAYMENTS.

	£	s.	d.
Printing and Stationery	65	11	3
Illustrations	14	2	6
Expenses of Meetings	6	13	6
Editorial and Clerical Expenses	16	16	0
Postages, Parcels, &c.	10	2	10
Investments	5	19	8
Advertisements	1	4	6
Charge for keeping Stock of Publications and Insurance	5	9	0
Repairing Lock	0	2	0
Balance	3	5	10
	£129	7	1

Examined and compared with the vouchers and found correct. (Signed)

BENEDICT KITTO,
F. W. RUDLER, } AUDITORS.

LIABILITIES.

	£	s.	d.
Editorial Expenses, 1887	10	10	0
Clerical " "	6	6	0
Subscriptions paid in advance	1	6	0
Williams & Strahan, Printing, &c.	6	12	0
Gas and Attendance at Meetings	1	11	6
Excess of Assets over Liabilities	247	6	11
	£273	12	5

ASSETS.

	£	s.	d.
Subscriptions for 1887 unpaid	17	6	0
" 1886 "	6	11	0
" 1885 "	2	2	0
Entrance Fee unpaid	1	1	0
New 3 per Cents. £210 4s. 9d. at 102½	215	9	7
Sale of Publications, Simpkin & Co.	10	13	0
Stock " average yearly sale	17	4	0
Cash in hand and at the Bank	3	5	10
	£273	12	5

(Signed)

ROBERT H. SCOTT,
General Secretary.

EXCERPT MINUTES OF COUNCIL MEETING.

Held at the Museum, Jermyn Street, May 8th, 1888.

The following gentlemen were elected Members :—

Henry Arnold Bemrose, Irongate, Derby.
Grenville A. J. Cole, F.G.S., Science Schools, South Kensington.
W. Crookes, F.R.S., 4 Kensington Park Gardens, W.
G. C. Hoffmann, Esq., Geological Survey of Canada.
Frank Rutley, F.G.S., Royal School of Mines, S.W.

GENERAL MEETING.

Held at the Museum, Jermyn Street, May 8th, 1888.

Rev. Prof. T. G. Bonney, D.Sc., F.R.S., as Treasurer, in the Chair.

The following papers were read :—

"Notes on some Minerals from the Lizard." By J. J. H. Teall, M.A., F.G.S. (p. 116.)

"Contributions to the Study of Pyrargyrite and Proustite." By H. A. Miers, M.A., F.G.S. (p. 37.)

"On Cornish Dufrenite." By Prof. E. Kinch, F.C.S. (p. 112.)

"On a Peculiar Variety of Hornblende from Mynydd Mawr, Carnarvonshire." By Rev. Prof. Bonney, F.R.S. (p. 103.)

"On a Picrite from the Clicker Tor District." By Rev. Prof. Bonney, F.R.S. (p. 108.)

GENERAL MEETING.

Held at the Museum of Science and Art, Edinburgh, June 28th, 1888.

Prof. Jas. Geikie, F.R.S., in the Chair.

The following papers were read :—

"A Mangano-Magnesian Magnetite." By Prof. Albert H. Chester, Hamilton College, U.S.A. (p. 125.)

"The distribution and origin of the Mineral Albertite in Ross-shire." By Hugh Miller, F.R.S.E., H.M. Geol. Survey. (Communicated by the Local Secretary.) Incorporated with a second paper which will appear in No. 39.

The Chairman remarked that mineralogists should keep to a theory of the formation of Albertite which agrees with observed facts, and then pointed to the crushed shales as the probable source of the mineral.

Prof. Macadam read his analyses in connection with Mr. Miller's paper, and exhibited specimens, including Albertite from Craig, Dingwall, Strathpeffer and New Brunswick, and Elaterite from Dingwall and Derbyshire.

"Elaterite, a Mineral Tar in Old Red Sandstone, Ross-shire." By Wm. Morrison, M.A., Rector of the Dingwall Academy. (p. 133.)

"The rockforming Feldspars and their determination." By Alex. Johnstone, F.G.S., and A. B. Griffiths, Ph.D., F.R.S.E. (Communicated by the Local Secretary.)

"A Scottish Locality for Bornite." With Analysis of Sample obtained by Mr. Morrison of Dingwall from Kishorn, by Professor Macadam. By Rev. W. W. Peyton.

"The Minerals of the Treshinish Isles." By Prof. M. F. Heddle, F.R.S.E. (p. 130.)

"On the Zeolites of Rye Water, Ayrshire." By Prof. M. F. Heddle, F.R.S.E. (p. 127.)

Prof. Macadam communicated certain analyses, viz. "Fichtelite" from Cheshire; "Coals" from Ohio and Canada; "Phosphorites;" "Galena" and other Minerals from Tyndrum; "Diatomite" from Mull. (p. 135.)

The following specimens were exhibited:—

The Duke of Argyll. Epidosite Marble and Pegmatite with Phlogopite rom Iona.

Dr. Balfour. A Series of Mineral Crystals.

Prof. Macadam. Pebble Sections from Lake Superior, and a Series of Crystals.

Mr. Peyton. Wilsonite, Fetid Quartz, Staurolite, Chrome-Garnet, red Calcite, and Labradorite from Canada.

Dr. Black. Gold Quartz from Wales.

ANNIVERSARY MEETING.

Held at the Museum, Jermyn Street, October 30th, 1888.

L. Fletcher, M.A., F.G.S., President, in the Chair.

The following Report of Council was read and adopted :—

REPORT.

The Balance Sheet for the year 1887, which was issued with No. 36 of the Journal, showed that the state of finances was not unsatisfactory. The excess of Assets over Liabilities was £247 6s. 11d., and the expenditure on the Journal during the year had been £79 13s. 9d., being about the average of late years.

The elections to the Society during the year have been 6, of which one is that of an Associate. The Council have to regret the loss by death of one of their Corresponding Members, Professor vom Rath, of Bonn, of whom an obituary notice by Prof. Lewis has appeared in No. 37 of the Journal. Mr. Solomon Birkett, one of the Associates, has also died, having been killed by a railway train near Whitehaven.

There have been 5 resignations, and the names of 10 members have been removed from the list in accordance with Rule XXX. (for non-payment of subscriptions).

Three meetings have been held since the last Anniversary, two in London, on January 10th and May 8th, respectively. These were held, as usual, in the Museum of Economic Geology, by kind permission of the Director-General of the Geological Survey. A third meeting was held in Edinburgh, at the Museum of Science and Art, on June 28th.

Three numbers of the Journal have appeared during the year, Nos 35, 36 and 37. The issue of the first, No. 35, was unfortunately delayed for more than three months, but the subsequent parts have appeared more promptly. The contents of No. 35 were various. No. 36 was chiefly occupied with papers on the structure of minerals. No. 37 is marked by its containing a monograph by Mr. Miers, modestly entitled "Contributions to

the study of Pyrargyrite and Proustite," which really consists of an exhaustive discussion of all that is known about these Silver Ores, in which Antimony and Arsenic replace each other in varying proportions.

The following were elected Officers and Council for the ensuing year:—

President.	R. H. Scott, M.A., F.R.S.
Vice-Presidents.	Rev. S. Haughton, M.D., F.R.S.
	Hugo Müller, Ph.D., F.R.S.
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	Prof. E. Kinch, F.C.S.
	Prof. W. Ivison Macadam, F.C.S.
	J. J. H. Teall, M.A., F.G.S.
	Prof. A. H. Church, M.A., F.C.S.
	Townshend M. Hall, F.G.S.
	Major-Gen. C. A. McMahon, F.G.S.
	J. Stuart Thomson.
	C. A. Burghardt, Ph.D., F.C.S.
	H. A. Miers, M.A., F.G.S.
	R. H. Solly, M.A., F.G.S.
	J. M. Thomson, F.R.S.E., F.C.S.
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Foreign Secretary.	T. Davies, F.G.S.
Auditors.	B. Kitto, F.G.S.
	F. W. Rudler, F.G.S.

The thanks of the Society were voted to the retiring Members of the Council, Messrs. Gurney, Peyton, Prof. Geikie, and Dr. Müller.

The following Papers were read:—

"The Renaissance of British Mineralogy." By L. Fletcher, M.A., F.G.S., &c., Keeper of the Mineral Department, British Museum. (p. 138.)

"On the supposed fall of a Meteoric Stone at Chartres, Eure-et-Loir, France, in September, 1810." By L. Fletcher, M.A., Keeper of the Mineral Department, British Museum. (p. 146.)

"Calcites from the neighbourhood of Egremont, Cumberland." By H. A. Miers, M.A. (p. 149.)

"On large Porphyritic Crystals of Felspar in certain Basalts of the Isle of Mull." By T. H. Holland, A.N.S.S. (Communicated by Prof. J. W. Judd, F.R.S.) (p. 154.)

"On a New Form of Microscope." By Allan Dick. (Communicated by the General Secretary.) (p. 160.)

Mineralogical Society—Abstract of Receipts and Payments from 1st January to 31st December, 1888.

RECEIPTS.

	£	s.	d.
Balance from year 1887	3	5	10
Subscriptions for current year	68	3	0
„ (arrears)	16	0	0
Entrance Fees and Compositions	35	19	0
Sale of Publications	15	0	9
Dividends on Stock	6	7	11
Repayments for Authors' Extra Copies	4	1	9
Postages, Advertisement, &c.	0	12	9
	£149	11	0

PAYMENTS.

	£	s.	d.
Printing and Stationery	60	6	3
Charge for keeping Stock of Publications and Insurance	5	9	0
Illustrations	4	9	6
Meetings 1887, Jan. 11th, May 10th, Oct. 25th	1	11	6
Travelling and Meeting 1888, June 28th	7	9	3
Editorial and Clerical Expenses	18	18	0
Postages, Parcels, &c.	10	4	0
Investments	27	7	11
Advertisements	0	14	6
Balance carried forward	13	1	1
	£149	11	0

Examined and compared with the vouchers and found correct. (Signed)

BENEDICT KITTO,
F. W. RUDLER, } Auditors.

LIABILITIES.

	£	s.	d.
Editorial Expenses, 1888	10	10	0
Clerical „ „	6	6	0
Williams & Strahan, Printing, &c.	70	18	9
Mintern Bros. Illustrations	9	10	6
Gas and Attendance at Meetings	1	11	6
Friedländer & Co., Payment in advance	0	5	6
Excess of Assets over Liabilities	215	0	7
	£314	2	10

ASSETS.

	£	s.	d.
Subscriptions for 1888 unpaid	18	2	0
„ 1887 „	5	5	0
„ 1886 „	3	3	0
Stock in $2\frac{3}{4}$ Per Cent. £237 13s. 7d. at $97\frac{1}{8}$	232	13	0
Proportion of Interest on Stock unpaid	1	12	10
Sale of Publications, Simpkin & Marshall	22	11	9
„ „ Office Account	1	2	9
Sale of Authors' Extra Copies	0	15	0
Stock of Publications: average yearly sale	15	16	5
Balance of Cash Account	13	1	1
	£314	2	10

(Signed)

L. FLETCHER,

General Secretary.

THE MINERALOGICAL MAGAZINE

AND

JOURNAL

OF THE

MINERALOGICAL SOCIETY.

No. 38. MARCH 1889. Vol. VIII.

A Mangano-magnesian Magnetite.

By Prof. ALBERT H. CHESTER, Hamilton College, New York, U.S.A.

[Read June 28th, 1888.]

A mineral from New Zealand, said to be chromic iron, presumably from its occurrence with serpentine, being found to contain no chromium, was analysed under my direction by Mr. F. J. Cairns with results given below. The mineral occurs both massive and crystallised in a light yellowish-green serpentine, with which it is so intimately mixed that it was found impossible to pick a specimen for analysis that was entirely pure, though as far as possible the distinct crystals were taken. These crystals are about one-fourth of an inch in diameter, and all noticed have the form of the rhombic dodecahedron. The specific gravity is 4·67, and the colour iron-black.

Analysis.

Fe_2O_3	...	...	66·71
FeO	...	...	19·62
Mn_3O_4	...	...	4·63
MgO	...	...	7·15
CaO	...	...	trace
SiO_2	...	...	2·38
		Total	100·49

The silica is probably not a constituent of the mineral, but comes fro the small amount of serpentine that could not be separated. Throwin this out, and with it an equivalent amount of magnesia, and re-calculatin to 100 per cent., we have the following as the true composition of th mineral, the atomic ratios also being given :—

Fe_2O_3	...	...	69·70 — ·436	·451
Mn_2O_3	...	...	3·32 — ·015	
FeO	...	...	20·50 — ·285	·431
MnO	...	...	1·50 — ·021	
MgO	...	...	4·98 — ·125	

From these figures the mineral is seen to be a magnetite in which par of the Fe_2O_3 is replaced by Mn_2O_3, and part of the FeO by MnO an MgO.

It may be called a mangano-magnesian-magnetite, a variety not notice heretofore.

On the Zeolites of Rye Water, Ayrshire.

By Prof. M. Forster Heddle, F.R.S.E.

[Read June 28th, 1888.]

THE first volume of the Transactions of the Geological Society of Glasgow contains the following notice of Zeolites as occurring in the banks of the Rye Water:—"About one-and-a-quarter miles below Howrat Toll-bar, white and red stilbite occur, small white prehnites, with fine pellucid quartz approaching to hyalite, and calcite."

As this locality was at a considerable distance from any other which I had visited, and as an association of stilbite of *two* colours was both new to me, and gave hope of the diversity of colour being associated with difference in crystalline form, I was desirous of visiting it. In the so doing I was fortunate in being accompanied by Mr. Blackwood, of Kilmarnock.

Having heard that some quarrying was going on about a mile further up the Glen than Howrat, in connection with new Water-works, we examined the rock so cut. No zeolite was found in its numerous amygdules, which were solely and solidly filled with calcite. This warrants, so far, the suspicion that the plagioclase crystals of the doleritic matrix may prove to be anorthite, and not as usual labradorite. These crystals, and those also of the associated olivine, are of such size as almost to make the rock a porphyry.

From Howrat for a distance of about a mile-and-a-half, the stream runs in a straight course, through a treeless, uninteresting flat, the turf of which is now and again cut through by projecting bosses of a rock very similar to that already noticed, but of extreme hardness. Suddenly, however, these features give place to a rocky copse-clad gorge, through which the stream forces its way with many windings. This gorge ceases at the Cunningham Beadland limestone quarry, where the Lower Coal Measures are brought in by a great downthrow fault. The length of the gorge, as measured on the map, is a little over a mile, but the meanderings of the stream afford probably twice that amount of ground for exploitation.

At or near the confluence of the South Burn, a bed of amygdaloid crosses the main stream. It is characteristic on account of the great total bulk of its amygdules, these being lined throughout with delessite, and filled for the most part solidly with pellucid highly cleavable calcite.

It is characteristic, also, from the matrix being composed chiefly of a minutely crystalline and highly calcareous paste, which carries large porphyritically disposed, and highly-kaolinised crystals of some felspar.

When we had passed over this bed for some distance down the stream, we found the stilbite, *apparently* both white and red, or rather flesh-coloured. This last was in the usual built up sheaf-like form, but of very minute size; it sometimes lined otherwise vacuous druses, and sometimes was imbedded in calcite.

It appeared at first sight to be associated with milk-white stilbite, in radiated, sheafy bundles; but this, upon closer examination, proved to be *quartz*. The error, however, was not surprising, so exactly did many of the diverging groups of radiating crystals simulate stilbite in habit. The hardness however, and the observing the terminations of the crystals in some cavities, sufficed for the determination.

The specimens, though quite insignificant in size, are very characteristic, and altogether different in appearance from anything I have seen in Scotland or elsewhere.

Radiating but isolated groups of singularly white and very opaque quartz, of the zeolitic habit, lie lowest in the cavity. These groups are set round with circlets and groups of flesh-red stilbite, while minute spheres of dark green delessite sparingly overlie both.

The dull and yellowish felspar (? anorthite) is zoned occasionally by delessite, and the crystal-margins are ill-defined.

Some half a mile or so further down the stream, we found in loose blocks of non-porphyritic amygdaloid, two specimens of analcime, and also two of chabasite, both in the primary rhombohedron and in twins of the same.

We could not find *in situ* the rock with the prehnite; but within half-a-mile of the opening of the gorge we found two loose masses of the rock which contained it.

This was a rock of entirely different character from that which carried the stilbite, being a dense and tough porphyry, with large crystals of opaque white plagioclase. The prehnite was not white, except where its crystals interfered with each other. It was colourless, and of high lustre. Occasionally several confluent radiating groups seemed to plug an amygdule; but the marked character of the mineral here is that it is *embedded* in divergent spherical groups of crystals in the rock-paste. The spheres are about the size of peas.

It was of necessity difficult to break up the fragments in every direction so thoroughly as to make certain of the fact, but I was unable after several attempts to find any point of attachment to the skin of a cavity, which had

acted as the centre or offset of the divergent crystallisation. The terminations of the individuals of the crystalline sphere seemed to abut upon the rock substance, without any intervening druse skin. This *indicates* radiation from a central point.

However anomalous and improbable the separation of prehnite as a primal solidifying substance from a fluent lava-flow may be, or however improbable its occurrence in such, otherwise than as a product of the change of a felspar, such is the appearance in this rock.

The sections of this and of the other rocks of the district which Mr. Blackwood is at present making will, however, throw much, if not an all-sufficient light upon the question. We found no hyaline quartz.

The dolerite of the flat near Howrat affords fine micro-sections, as both the olivine and the labradorite are in well-developed crystals.

The Minerals of the Treshinish Islands.

By Prof. M. Forster Heddle, F.R.S.E.

[Read June 28th, 1888.]

THROUGH the cordial assistance and generous hospitality of Mr. Brown, of Dunipace, formerly a member of the Mineralogical Society, I have lately been enabled to add very largely to the list of mineral localities in the Western Islands of Scotland.

Mr. Brown most ardently associated himself with me in my special pursuit, throughout the whole time when I was his guest during two yacht voyages,—visiting every island where there appeared to be any hopes of "a find," and revisiting such localities as had been already noticed by Macculloch or others.

I now lay before the Society a bare rescript of my notes on the Treshinish Islands, near Mull, as these will suffice to indicate the large amount of new information connected with the trappean islands generally which is now in my possession.

Our previous knowledge as regards these Treshinish Islands is, so far as I am aware, confined to the following statement regarding them in Macculloch's first volume :—

"The geological history of these islands is comprised in a few words. "They are all formed of trap rocks. The uppermost bed, where two are "visible, consists of basalt, having a perpendicular fracture but no "columnar forms. The second is an amygdaloid, containing indifferent "specimens of mesotype and analcime ; and where, as in some places, a "still lower bed is accessible, it is a repetition of the upper basalt."

Avoiding all geologic considerations, my notes on the minerals are as follows :—

Bachd More.—"The Dutchman's Cap." At the south-east corner in the lowest visible bed—a soft "basalt"—scolezite. In an overlying amygdaloidal bed, and markedly at the upper surface of that bed, very fine specimens of analcime *overlying* stilbite, and generally covered by "cottonstone" (mesolite).

At the summit of the island, in a disintegrating amygdaloid, analcime, and rarely chabasite, but in separate cavities.

The intervening bed of "basalt" appeared to be barren.

Bachd Beg.—Poor specimens of analcime, and of stilbite.

Lunga.—On the east side of its southern extremity, in amygdaloid, analcime *per se*.

Other cavities contain :—

Faröelite, scolezite, and analcime.

Faröelite, scolezite, and gyrolite.

Faröelite, scolezite, and stilbite.

The island closest to Lunga to the north, Sgeir a Chaisteal, contains at its south-east corner fine analcime ; and in other cavities chabasite *over* scolezite.

At its north-east corner it contains gyrolite.

The islet nearest to Fladda Sgeir an Our yielded nothing.

Fladda.—At its east-south-east corner, in the lowest visible bed, some cavities contain gyrolite overlying mesolite ; others have in addition apophyllite, which overlies the gyrolite.

An overlying basalt bed is apparently barren.

The next tufaceous bed contains cavities at its upper surface only ; some of these are solidly plugged with scolezite, analcime, and "cotton-cone" ; while others carry chabasite in simple twins, *overlying* scolezite.

The upper bed of basalt contains gyrolite only, and that rarely.*

Cairn a Burgh More and *Cairn a Burgh Beg.*—On the east side of both, in the lowest soft basalt bed, gyrolite over faröelite.

There are some points of interest in this record.

One is the frequent occurrence of gyrolite. There are but four localities in Scotland given for this mineral in Messrs. Greg and Lettsom's work —three of these on the authority of the present writer. Since its publication, I have found the mineral in twelve new localities only, in examining the extended shore-line of our western trap islands : and yet here, in a stretch of some half-dozen miles, we have five or six additional localities.

I still regard gyrolite as being, with the single exception of epistilbite, the rarest of the Scotch zeolites, and very much the most difficult to obtain in even fair specimens—now that the Skye localities are exhausted. Here, as elsewhere, the collector must not expect to gather good specimens unless he carry ponderous hammers and chisels, and can devote considerable time to the extraction. Indeed, the occurrence here of good specimens is, so far as I could ascertain, very questionable, as the apparently large druses which are seen prove, upon being excavated, to be for the most part little better than flat scales. They occur within an inch or two of the upper

* There is a small well-sheltered cove on the north-west side of Fladda, in which small craft, up to eighteen tons or so, could lie; and a rock-cave near its head is comfortably covered over at its entrance.

surface of a dense though somewhat soft bed of amorphous dolerite ; they have a form which is similar to the vesicles of air which collect beneath the ice of a frozen pond : and they convey to the mind very forcibly the impression that pre-existent vesicles of aqueous vapour had risen through the substance of a plastic flow until they had been arrested, and had been at the same time flattened horizontally, by coming in contact with a chilled and rigid crust.

The dominance of plugged steam-pores in the *upper* portion of the amygdaloidal beds is beautifully apparent in these islets, and tells its own tale simply and unmistakeably.

The writer obtained one specimen of gyrolite which has crystals which show definite faces, and hence he has hopes of being able to determine the crystalline form of the species.

The frequent occurrence of scolezite, elsewhere rare in Scotland, next calls for remark.

Another point of interest is that, in the cases indicated in the foregoing list by *italics*, the order of formation—solidification—deposition—or whatever term is most fitting—of the several zeolites—*i.e.* from without inwards to the centre of the druse, is sometimes departed from.

This order may be said to be an absolute one. It is a rule exemplified, I find, by numberless examples, and it is a subject which cannot but throw much light upon rock decomposition.

It is a subject, however, in which fixed chemistry must go hand in hand with speculative geology, and so I must not enter upon it here, the more so that it stands apart from the purpose of this note, which is to show that much yet remains to be done in the working up of mineral localities.

Elaterite: a Mineral-Tar in Old Red Sandstone, Ross-shire.

By Wm. Morrison, M.A.

[Read June 28th, 1888.]

Physical Properties.

THIS mineral tar, which, from its elasticity, though somewhat weak, resembles elaterite, is found at the Craig Well, near Dingwall.

It is an intensely black, lustrous, sticky substance, of the consistency of tar, and from its being associated with albertite it may be looked upon as a variety of that asphalt.

The streak of both is reddish-brown. They are both insoluble in acids and strong alkalies. They are equally so in alcohol. In paraffin oil the tar is soluble; the albertite is not. A compact variety of mineral-tar from Egypt—the bitumen of the embalmers—resembles albertite except in its being soluble in paraffin. In ether the Dingwall tar as well as the Egyptian variety is partially soluble, leaving an insoluble residue, which is inflammable. The solution in each case is reddish-brown in transmitted, dark green in reflected light. The Egyptian substance shows besides this dichroism a strong, broad absorption band near the D or sodium line of the spectrum. The Derbyshire elaterite, found in the Carboniferous Limestone of the district, is soluble to the same degree as these, but shows neither absorption bands nor dichroism. The solutions of elaterite, the Dingwall tar, and the Egyptian bitumen, when rapidly evaporated show a vivid green film, which for duration and brightness depends on which of the solutions are so treated. Neither ozokerite, amber, torbanite, nor albertite shows a like property.

Chemical Properties.

With dry distillation the Dingwall substance yields an inflammable oil, an inflammable gas, and water. It melts, as the Derbyshire elaterite does, at or about 140°C., leaving on ignition a slight ash which shows ferric oxide and lime. These latter are evidently from the pyrites and calcite particles which are included in the mass of the tar. Indeed, the chinks in which the tar is found are lined with calcite crystals and iron-pyrites indicating the previous open state of the fissure up which the tar flowed. The sandstone rock in which this tar is found is soft and porous. The minutest pores of the rock in the neighbourhood of the fissures are filled with the tar.

Geological Position.

The mineral albertite is found in fissures in the conglomerate above the Old Red, in the O. R. Sandstone itself, in the laminated shales beneath, and in the micaceous schists underlying these in turn. The tar is found in the porous sandstone only, overlying the shales proper, and in close proximity to veins of albertite, as in the conglomerate of quartzite overlying the Old Red in the cutting on the Highland Railway near the Craig Well.

The geological horizon of the shales in which these asphalts are found is the lowest in this country for asphalts; and, indeed, anywhere, unless we place the natural gas and oil-bearing rocks of Ontario and Pennsylvania on the same level with them. There those products are found as far down as the Trenton limestone of Silurian age. Here the bituminous shales rest on the micaceous schists of the N.W. Highlands. The presence of an asphalt in these schists underlying shales themselves penetrated by veins of asphalt raises the question as to whether these shales after all are the source of the asphalts, or whether they may not owe their bituminous contents to a deeper source. That the question is not an easy one to settle is seen from the prominence recently given to the rival theories of Mendelejeff and Williams. The latter holds that the asphalts are altogether from shales containing organic matter; the former that these hydrocarbons are formed by the synthesis of hydrocarbons from hydrogen set free from super-heated steam and carbon from carbides of iron in the depths of the earth. The solution of the problem in favour of either of these theories, as is obvious, is of the highest economic as well as scientific importance. What adds somewhat to Mendelejeff's theory, in my opinion, is the presence of sheets of siliceous rock—Lydian-stone—deeply impregnated with some form of hydro-carbon, which I found among the archæan rocks of Lewis, as may be seen at the head of Loch Shell, on the South-East of that island. This black flinty rock lies on the coarse crystalline gneiss of the district, and dips at a low angle to the N.W. The significance of this fact—that of Lydian-stone on so low a horizon—adds, I think, some weight to the chemical theory for the origin of asphalts, oil, and gas in such deep-seated formations. The appearance of the Strathpeffer shales in many instances looks as if it were but saturated with an overflow of hydro-carbons from a subterranean source. There is, of course, much to be said for the organic —the "fish-bed"—theory of the shales, though no trace of any fossil other than that of a minute crustacean, recently found in one instance, is to be found in these Strathpeffer shales. This crustacean, I may mention, is of the genus *Estheria*, and was discovered by Mr. Hugh Miller, of H. M. Geological Survey.

Analyses of various Mineral Substances.

By Professor Ivison Macadam, F.R.S.E., F.I.C., F.C.S.

[Read June 28th, 1888.]

Diatomite from Mull.

THE samples analysed came from the bottom of a small loch. No. 1 was of a yellow-gray colour, even in texture, and readily broken down between the fingers.

No. 2 was distinctly red, and marked with dark spots. It broke down readily, and was more dense than No. 1.

No. 3 sample was red in colour, with dark brown and red particles throughout the mass.

The analyses of the samples as received gave :—

	No. 1.	No. 2.	No. 3.
Moisture	2·421	3·114	3·021
Organic Matter ...	5·074	6·155	6·368
Ferric Oxide ...	11·809	38·057	26·836
Calcic Oxide ...	1·188	1·301	0·531
Soluble Silica ...	0·489	1·078	0·829
Insoluble Silica ...	78·085	49·291	61·998
Carbonic Anhydride, &c.	0·934	1·004	0·487
	100·000	100·000	100·070

The insoluble silica was found to be, when examined under the microscope, a mixture of sand and diatoms. On separation the following figures were obtained :—

Percentage on substances as received :—

Diatoms	75·254	46·579	55·887
Sand	2·831	2·712	6·111
	78·085	49·291	61·998

When calculated, free from moisture and organic matter, the results become :—

	No. 1.	No. 2.	No. 3.
Ferric Oxide ...	12·954	42·929	30·029
Calcic Oxide ...	1·304	1·467	0·594
Diatoms	82·622	52·543	62·426
Sand	3·108	3·059	6·927
	99·988	99·998	99·976

Specific gravity (Water, 1000) ...	1379	1448	1389
Weight of 1 cubic foot	85·93 lbs.	90·24 lbs.	86·56 lbs.
Cubic feet of Material to 1 ton ...	26·06 c.ft.	24·82 c.ft.	25·85 c. ft.

These results show that this deposit is much less pure than those at Loch Kinnord, in Aberdeenshire,[1] Skye,[2] Gress in Lewis,[3] &c.

Elaterite.

No. 1 Sample was obtained from Derbyshire, and is the usual elastic body.

No. 2 Sample was also from Derbyshire.

No. 3 Sample is a mineral pitch obtained by Mr. Morrison from the Strathpeffer shales near Dingwall. It is more like a pitch and less elastic than the Derbyshire specimens:—

	No. 1.	No. 2.	No. 3.
Carbon	83·624	82·798	81·186
Hydrogen	11·186	11·925	13·372
Oxygen, &c.	4·781	4·916	4·453
Nitrogen	0·172	0·115	0·127
Sulphur	0·237	0·246	0·862
	100·000	100·000	100·000

Bornite and Malachite from Kishorn.

These samples were forwarded to me by Mr. Wm. Morrison, of Dingwall, and were obtained by him from the limestone rocks at Kishorn, Loch Carrow, Ross-shire. The ores were formerly worked for copper, and the mines were quite recently explored by parties in view of working.

Malachite.

Cupric Oxide	71·86 per cent.
Carbonic Anhydride ...	18·27 ,,
Water	9·86 ,,

Bornite.

Copper	60·02 per cent.
Iron	16·08 ,,
Sulphur	23·86 ,,

Galena and Sphalerite from Tyndrum, Perthshire.

The Galena was worked many years ago for smelting into lead. The analysis gave:—

Metallic Lead	82·56 per cent
Silver	0·15 ,,

[1] *Min. Mag.* Vol. VI., p. 87.
[2] *Min. Mag.* Vol. VII., p. 35.
[3] *Min. Mag.* Vol. VI., p. 87.

It is therefore rich in silver.

The *Sphalerite* gave :—

Zinc	61·86	per cent.
Sulphur	32·15	,,
Gangue	5·99	,,
	100·00	

Fichtelite.

No. 1 Sample was obtained under the bark of semi-fossil pine logs in a moss near Handforth, Cheshire, and was given me by J. Plant, Esq., of Salford Royal Museum.

No. 2 Sample was found in a peat moss in Shielding, Ross-shire. The whole of this district was at one time covered with pine forest.

	No. 1.	No. 2.
Carbon	86·782	87·148
Hydrogen	12·175	12·082
Oxygen, &c. ...	1·043	0·775
	100·000	100·000

The general characters are similar to those given in Dana's Mineralogy.

The Renaissance of British Mineralogy.

By L. Fletcher, M.A.

[Read by the retiring President at the Annual Meeting, Oct. 30th, 1888.]

IT is my unpleasant duty this evening to retire from the honourable position in which I was placed by the members of the Mineralogical Society three years ago. Before doing so I would say a few words on a subject which has demanded grave consideration from myself, and doubtless also from my predecessors in the Chair: namely, as to whether any formal address should be delivered by your President during his term of office.

Our Society, instituted only twelve years ago, is still in its early youth, and is as yet unrestrained by the unyielding bonds of traditional custom. Its precedents are now in process of being made, and we must have a care that they be such as may safely be followed in the distant future without detriment to the true interests of the Society.

This question is one which must, sooner or later, become of vital importance, and deserves our serious attention.

Let us first recall, by reference to the printed Proceedings of the Society, the course which has been followed by my four predecessors in the Chair. We find that our first President, Mr. Sorby, during his three years of office, gave a single address, a very valuable one, on the determination of the chief optical constants of minerals. Of Professor Heddle no formal presidential address is recorded. Mr. Hudleston went so far as to express his happiness that it was not the custom to deliver an address. My immediate predecessor, Professor Bonney, pointing out that an address was not a matter of fixed precedent, said that he had hoped to have escaped, but that at the urgent request of our energetic Secretary he had prepared what he preferred to call "some remarks."

So much for the practice of our own Society. Let us now consider what is the custom in such of the other learned societies as are most nearly related to our own. At the Geological Society the President delivers a set annual address, which precedent requires to be of so lofty a character that during his whole term of office, instead of rejoicing over his dignities, he feels life to be a heavy burden, and is ever wistfully looking forward to a happy day in February when he will once more be freed from the oppressive responsibilities of his office. At the Chemical and Physical Societies

the set address on a specific subject is replaced by a report on the progress of the society or of the science during the preceding year.

Now it seems to me that a presidential address on a specific subject is out of place. However valuable the address in itself, expressing, as it often does, the results of years of patient study, it might with greater propriety and with equal effect be brought forward by the author in his unofficial capacity. The convenience of the latter method to the author himself is obvious; for an important scientific paper, founded on observation and perhaps also on direct experiment, should be published when complete, and not be required or reserved for a definite date.

An ideal presidential address should treat, not of a special point in the science of interest to a section only of the Society, but of the science in its broader aspects; and the simplest permanent arrangement of this kind is that which makes it deal with the progress of the society or of the science during the interval which has elapsed since the delivery of the next preceding address.

But in the case of our own Society we labour under special disadvantages, whether the address is to be on a specific subject or on the progress of the science. Not only is the Society small, but the number of its members able to devote any large part of their time to pure Mineralogy is far smaller still. Hence, if a set address were expected from the President we should be unnecessarily limited in our selection for that office. Many of our ablest members, men who would make the best of presidents, men of wide culture and extensive general knowledge, men endowed with ideas and the power of expressing them, men who would bring to us a large experience obtained on the executive of other and larger societies, though willing, nay anxious, to help us in the management of the affairs of the Society, would be prevented from giving us their services in the Chair owing to the sheer impossibility of devoting the requisite time and thought to the preparation of a purely mineralogical address such as they would consider worthy at once of the Society and of their own reputation.

Again, the number of our London meetings has been up to the present only three a year, and, as far as we can see, it is not yet desirable to increase their frequency. To set aside annually one-third or even one-fourth of the time of the Society for consideration of the views of the President or of the progress and past work of the Society would seem to be wanting in regard for proportion. A few minutes spent by the members in turning over the pages of the Magazine will give a better idea of the work of the Society, and be at the same time more exhilarating, than any summary a President can make.

A report by the Council on the finance and general business, as brief as it can be made, seems to me sufficient for all reasonable purposes, and least wasteful of the time of the members and officers.

I have referred to the Magazine, and have said that a good idea of the work of the Society may be obtained in a few minutes by turning over the pages of one of its volumes. It may be cast in our teeth that the volume is small, but we can proudly and truly retort that few volumes of the same size furnish so vast an amount of heavy reading. The density, indeed, is prodigious—not that of lead, but of gold, refined gold. The volume is intended for transmission to all posterity, and not as a mere addition to the ephemeral literature and scientific gossip of a too prolific century. The present generation, by its careful use of the volume, will doubtless help it to reach its destination.

Bulky publications are indeed matters for shame rather than pride: they are the immediate ruin of a small society, a perennial burden to librarians, and, as their contents are never completely indexed, a terror to subsequent investigators. The Ancients, not unwisely, refrained from the invention of printing: they recognised that their duty to themselves was to read only what was worth the vast labour of transcription, and that their duty to posterity was to transmit to it only their masterpieces: when even these became burdensome, an incendiary, doubtless a librarian, quickly reduced their volume. But for us Moderns the cost of multiplication of copies has become so small that everything, good or bad, is printed and preserved, and it becomes necessary to spend the greater part of one's life in the preparation and study of indexes rather than of the literature itself.

It would be an immense boon to mankind if some impartial and perfect tribunal could be empowered to do on the large scale, what the curate and barber did so satisfactorily with Don Quixote's books on the small scale; distinguish the worthy from the worthless, and relentlessly annihilate that which ought not to cumber our shelves or demand even a passing glance.

I have said that the number of our members is small: I am not sure that it would be politic as yet to increase it. Members who have a living interest in Mineralogy are most valuable, and of such we cannot have too many; but mere subscribers of paltry gold would be eventually a source of weakness. After encouraging the Society to extravagant expenditure, they would fall away and leave it in the lurch.

But is it necessary that the number of people in this country with a lively interest in Mineralogy should remain so small? We have only to

book abroad to see at once that the cause of this smallness of number is not inherent in the subject itself. In Germany, for instance, every one, of course with here and there a conspicuous exception, seems to be either a professor of mineralogy or a student of it. Periodical publications, at once voluminous and teeming with valuable results of scientific work, are there maintained. Somewhat more than a century ago the study of minerals was everywhere popular, and received its share of attention from the cultured classes. Students thronged to Freiberg from all parts of the world to hang on Werner's lips.

There is one reason for this decline of general interest in Mineralogy which I may mention in passing. In the good old days minerals were named and classified by help of simple external characters, and the facts of the science could be easily grasped without much preliminary training. Since then, the invention of crystallography and of the atomic theory, and the discoveries made in physical optics, have brought about a vast change in the treatment of the subject, and the Mineralogy of to-day is given in its elements beyond the range of ordinary mortals, The pages of its text-books are sprinkled with wonderful formulæ designed by perverse chemists, and with unpronounceable hieroglyphics maliciously invented by cruel crystallographers.

But the chief reason for the decline of mineralogical study in our own country is that mineralogy has been almost completely excluded from our educational system. In the older universities, it is true, mineralogy has been long represented by professors, but until lately at least it has been allowed scarcely any weight in the examinations for a degree. The study of other branches of science has been encouraged, while that of mineralogy has been neglected and forgotten. One of the evils of the examinational system is that all the available energy of our youth is concentrated wholly on subjects upon which stress is laid by a not omniscient examining board. Most students too must almost necessarily take up subjects in which there is an opportunity of showing their comparative ability, and by a knowledge of which there is a reasonable prospect of being able to gain a future livelihood.

Taught only as a subordinate and unimportant subject at the universities, and not taught at all outside, pure mineralogy has been in danger of becoming extinct in this country: a few years ago the capsizing of a coach or the bursting of a balloon might have been the end, and the British professor or student of pure mineralogy have become a mere tradition.

The discovery of the transparency of thin rock-sections, and the

important conclusions which may be arrived at from their microscopical examination, have now turned attention to mineralogy once more, and it seems likely that the knowledge of mineral characters requisite for petrographical work may at last lead to our mineralogical *Renaissance*. Owing chiefly to the patience and perseverance of Professor Lewis, there is now a certain amount of encouragement to mineralogical study at Cambridge: and if the *Renaissance* is to be brought about, the example of Cambridge must be followed by the other universities, and mineralogy be assigned a higher place in the examinational system.

Minerals are omnipresent. Is it unreasonable to ask that every one should be taught their simpler characters, and be shown how to recognise the minerals which are met with at every turn? Such teaching would improve the capacity for observation, and give fresh interest to many a pleasant ramble—through the workings of a mine. And is not Professor Ruskin in the right when he claims that a knowledge of the minerals, conveniently grouped as precious and ornamental, should form a part of every gentle education? Ought we not more especially to insist upon such elementary teaching for the numerous officials sent out by the nation to the less explored regions of the world?

In the higher teaching of mineralogy difficulties present themselves, but they might easily be lessened by division of labour; a preliminary training in the elements of mathematics, physics, chemistry and crystallography being absolutely necessary to the manufacture of a mineralogist. The teaching of crystallography is generally relegated to the professor of mineralogy, and the subject is regarded as a mineralogical difficulty; but this ought not to be the case. It is true that a mineralogist was the first to discover a relationship between the various crystallised forms of the same substance, and thus to institute a crystallographic science which has since been found indispensable in mineralogical study. It is true that a mineralogist has been the originator of every advance in crystallographic knowledge. It is true that a mineralogist has in minerals ready-made crystallisations, which in their excellence and variety of form can rarely be imitated in the laboratory. But it is no more the province of a mineralogist to teach crystallography than it is to teach chemistry, or the use of a delicate balance. He does teach it indeed, but that is merely because his pupils reach him imperfectly trained for the pursuance of his own subject.

Crystallography should be taught as a special subject; and a knowledge of it should be required, not only of the mineralogist, but of the chemist and even of the physicist. Hitherto, at least, the chemists of this country

have been too content, either to leave the crystalline forms of their artificial products undetermined, or to impose the task of their determination on the already sufficiently occupied mineralogist. It seems obvious that in a satisfactory system of education every chemist should be taught how to measure and describe the crystalline characters of the products which it is his fate to call into existence. On various occasions expression has been given to this view, but the only chemist who has yet seen his way to act upon it is Professor Henry Armstrong, who, I am happy to say, has introduced the subject into the educational course at the City and Guilds Technical Institute. I trust that before another generation passes away his excellent example will be followed throughout the country. A knowledge of the elements of crystallography, including the mechanics of crystal-measurement, ought to be made a *sine quâ non* for a degree in chemistry at every university.

The measurement of the angles of a crystal, the determination of its symmetry, and the calculation of its form, are infinitely less difficult than is generally imagined: given a knowledge of elementary mathematics and of the careful use of measuring instruments the processes are in general extremely simple. The complexity of crystallographic calculation is only apparent, and is due to the existence of text-books. These are generally worse than useless. A voluminous work on crystal-calculation is usually an attempt to provide formulæ which shall enable a student to solve every possible problem by rule of thumb, without his needing to have the faintest idea of what he is really doing. Practically any one familiar with the processes of trigonometry can deduce from first principles the formulæ required for each special case, as it occurs, in less time than he can discover the rule in the ponderous tome invented for his mystification. I am of course far from asserting that the teaching of crystallography presents no difficulties at all. What I do wish to insist upon is that the kind of crystallographic knowledge required for the chemist in his own work is such that it may fairly be demanded of every one of them. The higher flights may be abandoned to the specialist.

At the present time, when professors of crystallography are not yet called into existence, there is one step which ought to be at once taken, and which would make mineralogy more possible eventually to a large number of our students. Every student of practical physics is taught how to measure with a reflecting goniometer the angles of an artificial prism. He should further be taught the measurement of the angles of a simple crystal, and the deduction of its symmetry. In his optical studies especially such a practical knowledge of crystalline symmetry would be of great

help to him. The reflecting goniometer in one of the forms used for crystallographic work might well be an instrument in use in every physical laboratory, and would subserve many a useful purpose.

As soon as every physicist is taught how to determine the angles and symmetry of a simple crystal, and every chemist is further enabled to define the crystalline forms of his artificial products, we shall have a large army of students for whom the transition to mineralogical work will be easy; then, and not till then, can we hope for any useful increase in the number of the members of this Society; then, and not till then, can we hope that our country will in its study of mineralogy take its proper place among the nations of the earth.

One more point I may mention. Until a few years ago there were two distinct societies—a Mineralogical and a Crystallological. They had objects far from identical, and in a more perfect world might have flourished side by side. The fusion of the two societies without any extension of the title of the Mineralogical has had for its effect that we cannot satisfactorily demand what the Crystallological could—namely, the support of the organic chemist; and although it was understood at the time of the fusion that papers on the crystallisation of artificial products, organic or inorganic, should be within the scope of the joint society, their inclusion in a *Mineralogical Magazine* would suggest a misnomer. The change or extension of our already lengthy title has its evident inconveniences, but it may be worthy of careful deliberation by the Society at some early date as to whether such an extension is not really necessary for the clearer definition of our objects if we are to enlist the sympathy of many who, though they may feel to be beyond the pale of a mineralogical society, yet by their investigation of the crystalline forms of the products of the laboratory may in the future, as in the past, throw light on the crystallography of the mineral kingdom.

With these few words I now give place to my successor in the Chair. His past services as Honorary Secretary *pro tem.* are familiar to us all. For seven long years he has undertaken the heavy responsibilities of his office, and by his zeal and devotion and by his knowledge of business has rescued the Society from those pecuniary dangers which at one time threatened it. Thirty years have now flown by since Mr. Scott began to publish the results of his mineralogical study. At one time in the quiet laboratory at Dublin analysing a felspar from the Urals, at another wandering o'er the wild districts of Donegal for the observation of its granites, or in stern Caledonia investigating the minerals of Strontian, or once more in Dublin preparing with Professor Haughton the Blowpiper's

Vade Mecum, his researches and publications were at one time frequent and varied. But in an evil hour for himself and his old love he was allured from the narrow path by the charms of a fickle goddess, and mineralogy has, since then, obtained his regard during only an occasional passing hour. But even this was at last to be denied. The Meteorological Muse, grown still more arrogant, would no longer brook a rival, and demanded his whole attention. It is divulging no great secret when I tell you that it required much pressure to obtain Mr. Scott's consent to his being nominated as President on his vacation of the secretarial office. Conscience-stricken, he seemed to feel that the intimacy of his relationship to Meteorology was a bar to his acceptance of the highest dignity the Mineralogical Society can bestow. The Council considered, however, that his meteorological relationship should be ignored in consideration of his many years of faithful service here, and ventures still to entertain the hope that his leisure hours at least may be reserved for this Society during many years to come.

On the supposed fall of a Meteoric Stone at Chartres, Eure-et-Loir, France, in September 1810.

By L. Fletcher, M.A., President, Keeper of Minerals in the British Museum.

[Read October 30th, 1888.]

In a list of the known falls of meteorites published by Meunier in 1884[1], is a record of the fall of a meteoric stone at Chartres, Eure-et-Loir, France, in September 1810, and as authority is quoted the catalogue of the meteorites of the Muséum d'Histoire Naturelle at Paris. No stone of that name is mentioned in the printed list of the Paris collection published in 1882, but according to a later manuscript five grams were in the Museum in the year 1885. The anthenticity of the fall is accepted in the lists since published at Vienna and at Harvard College. No representative of the fall, however, appears in any other list of the better known meteorite collections, and it seemed that only the fragment at Paris had escaped destruction. Lately, however, on receiving from Professor Lewis a manuscript list of the meteorites under his charge, I was agreeably surprised to find that a piece weighing no less than 60 grams of a Chartres stone was in the Cambridge collection. The specimen and its label were sent to me for inspection, and they suffice in my opinion to prove that the Chartres fall of September 1810 is mythical, and owes its origin to a simple error of memory.

The Cambridge specimen is part of the collection bequeathed by H. J. Brooke, Esq., F.R.S., to the University, and is accompanied by a label bearing the following inscription:—*Metéorite d'une commune pres de Chartre en Bauce, Septembre 1810.* As regards the orthography of this label, we may direct attention to the omission of the accent from the first *e* of *Météorite* and from the *e* of *pres*, to the omission of the *s* from *Chartres*, and of the first *e* of *Beauce*.

Chartres, 50 miles S.W. of Paris, is the capital of the department of Eure-et-Loir and the seat of a bishopric, and is identical with Chartres en Beauce, Beauce being a district of the ancient province of Orléannais.

Having regard to the identity of indefiniteness of the record by Meunier and of the Cambridge label, we can have no hesitation in inferring that

[1] Encyclopédie chimique, Tome 2; Appendice, 2me cahier, p. 510.

ne two collections have derived their information about the fall from a ngle source. As far as I can discover, no printed particulars of such a ll have ever been published, and its authenticity would seem to rest erely on the accuracy of a label. But if we give the matter our con-deration, it will be seen to be incredible that a fall can have taken place t that date so near Paris, and a stone have been preserved, and yet no port have been published at the time. At the beginning of this century en of science had only been just convinced of the reality of the fall of ones from the sky, and were anxiously awaiting material for further ex-mination. Hence when a fall actually did take place on 23rd November, 810, in the Commune of Charsonville, about 30 or 40 miles from Char-es, voluminous reports from numerous observers were published, stones ere carefully searched for, fragments were sent to Vauquelin at Paris for nalysis, and specimens are still preserved in most of the meteorite collec-ons in the world. Bigot de Morogues, an enthusiast in all that concerned eteorites, resided within easy reach of Charsonville and Chartres, and ersonally took part in the collection of information relative to the Novem-er fall. In his well-known book[1] he devotes more than thirty pages to mere summary of the reports which had been made relative to the eteorites of Charsonville. If there had been a stone-fall in the same art of France only two months before he could not have failed to have eard of it, and yet he makes not the slightest mention of even a rumour f such an event.

Is not the explanation simply this? A fragment of one of the Charson-ille stones having been preserved for some time without label, was at last rovided with one, the writer of the label trusting to his own or someone lse's memory for his statements. He felt that the Charsonville fall was o far famed that the indefiniteness of the label could lead to no confusion. n any case, he had certainly forgotten the name of the commune and the lay of the month; and in his defence we may observe that the commune of Charsonville is, however important celestially, of so little terrestrial signifi-ance that it is not entered in any ordinary atlas. Is it not clear that, aving forgotten the name of this unimportant commune, he introduced he name of Chartres as being that of the capital city of what he considered o be the district of the fall? Further, would it not be easy for him to eproduce correctly the number of the year and yet write September in-tead of November as the name of the month? The orthography of the abel, called attention to above, is enough to cast doubt on the accuracy of

[1] Mémoire historique et physique sur les chutes de pierres. Orleans, 1812.

its writer. Even under most favourable circumstances dates are often wrongly given: in the case of the Estherville fall of May 10th, 1879, we had within a month a choice of three dates for the correct one. The Cambridge specimen supports this view: it is encrusted only on one side, and that side is almost flat, proving that the specimen is merely a very small part of a much larger stone. When it is directly compared with an authentic specimen of the Charsonville fall, the last vestige of doubt as to the accuracy of this explanation disappears: in thickness and general appearance of crust, in aspect of fractured surface, and in microscopic characters of a thin section the two are identical.

Calcites from the Neighbourhood of Egremont, Cumberland.

By H. A. Miers, M.A.

[Read October 30th, 1888.]

A REMARKABLE series of crystallised calcites from Cumberland which have been found during the present year deserve description, both on account of their size and beauty, and also by reason of their peculiar form.

The crystals, although obtained from a small area, exhibit great variety of habit and appearance, and fall naturally into the seven groups which are described below. Of these the most remarkable consists of a series of magnificent heart-shaped twins, somewhat similar to the rare but well-known "butterfly twins" of Eyam, in Derbyshire; they result from the same mode of twinning as the latter, but are far larger and more beautiful than any of the Derbyshire twins, frequently measuring four inches in breadth. There are also crystals which exactly resemble the true butterfly twins of Eyam, and others which are very similar to the rectangular twinned prisms of Wheal Wrey in Cornwall. A second and very rare twin law is also represented among these specimens, in which the rhombohedron, whose edges are truncated by the cleavage planes, acts as twin-plane. The majority of the specimens, however, consist of perfectly limpid and colourless prisms, terminated by brilliant rhombohedron faces, which in their transparency and symmetry of form rival the calcite from any other known locality.

All these varieties have a matrix of earthy hæmatite from which they are easily separated, and most of the crystals are slightly stained with earthy oxide of iron of a red, yellow, or brown colour. In the simple crystals the staining is rarely more than superficial, but some of the twins (4) are rendered almost opaque by the dark brown earthy matter with which they are impregnated.

The heart-shaped twins owe their beauty largely to the fact that they are attached to the matrix merely by the apex, so that they are completely and symmetrically developed in every direction. One variety alone (2) is associated also with pale blue barytes of later growth than the calcite.

In all the varieties the predominant forms are those which are characteristic of the calcites from the North of England, namely $\{2\bar{1}\bar{1}\}\ \infty R$, $\{20\bar{1}\}\ R3$, $\{100\}\ R$, $\{10\bar{1}\}\ \varkappa\ R2$, $\{3\bar{1}\bar{1}\}\ 4R$, and planes in the zone

[100, 010] forming a rounded and striated surface which replaces the rhombohedron $\{110\} -\frac{1}{2}R$.

The physical characters of the faces are as follows: $\{100\}$ and $\{3\bar{1}\bar{1}\}$ are perfectly lustrous and smooth; $\{20\bar{1}\}$ is striated with curved lines nearly parallel to $\{100\}$; $\{2\bar{1}\bar{1}\}$ is uneven and dull, covered with curved triangular elevations of which the apex is turned toward the adjacent face of $\{100\}$; $\{10\bar{1}\}$ is striated parallel to $\{20\bar{1}\}$.

There is also a new scalenohedron described under (2); and several scalenohedron faces lying in the principal zone occur between $\{20\bar{1}\}$ and $\{10\bar{1}\}$. The crystals are sometimes corroded, as by the action of some solvent, in which case $\{2\bar{1}\bar{1}\}$ has a drusy surface entirely formed by the triangular elevations mentioned above, and numerous etched planes appear in the neighbourhood of the prism edges.

Varieties. (*A*.) Simple crystals.

(1.) Prismatic habit.

Clear, transparent prisms $\{2\bar{1}\bar{1}\}$, sometimes having their edges truncated by small faces of the prism $\{10\bar{1}\}$, terminated by brilliant rhombohedron planes $\{100\}$, which have the appearance of cleavage surfaces, but are true planes of growth. The edges of the rhombohedron are replaced by the curved and striated faces $\{110\}$. The primary rhombohedron not unfrequently disappears, so that $\{110\}$ constitutes the sole termination. All the crystals of this variety have also below the rhombohedron $\{100\}$ small faces of the forms $\{20\bar{1}\}$ and $\{3\bar{1}1\}$.

On one crystal curved faces were found truncating the edges between $\{11\bar{2}\}$ and $\{3\bar{1}\bar{1}\}$, and inclined at an angle of about 28° to the latter.

Some of the prisms attain a length of about 100 mm. and a breadth of 85 mm.

(2.) Pyramidal habit.

Prisms $\{2\bar{1}\bar{1}\}$ and $\{10\bar{1}\}$, terminated by brilliant faces of the rhombohedron $\{100\}$ without any trace of the usual striated truncations upon its edges, also $\{20\bar{1}\}$; the predominating faces, however, belong to a new form which very nearly coincides with the prism $\{10\bar{1}\}$ and gives the crystals the aspect of very acute hexagonal pyramids. The scalenohedron $\{20\bar{1}\}$, though generally large, sometimes disappears entirely, in which case the predominating forms are the acute scalenohedron and the prism $\{10\bar{1}\}$.

The new faces are capable of accurate measurement, since, though always dull, they give very definite images on the goniometer, and the measurements establish beyond doubt that the form is a negative scaleno-

hedron having indices near $\{161 . 10 . \overline{144}\}$ $-\frac{1}{9}R\ ^{3}\frac{9}{3}^{5}$, and not a hexagonal pyramid.

The following measurements were made upon one very perfect crystal, and are fully confirmed by others.

	Observed.	Limits.	Number.	Calculated.
Acute edge ...	60°19′	60°18′ — 60°22′	3	60°17′
Obtuse edge ...	58°59′	58°58′ — 59°0′	3	59°0′

The reflections yielded by these faces are accompanied by faint but definite reflections belonging to a scalenohedron with the dihedral angles 60° 0′ and 59° 16′.

The prism $\{10\bar{1}\}$, though bright, is striated not only, as mentioned above, parallel to $\{20\bar{1}\}$ but also horizontally by oscillatory combination with the new scalenohedron.

This variety has the usual matrix of earthy hæmatite, but is associated with pale blue tabular crystals of barytes ($\{001\}$ $\{110\}$ $\{100\}$) which are penetrated by the calcite; other specimens of the same barytes have also quartz and limpid crystals of scalenohedral calcite of the form common in the north of England.

Crystals of this habit are extremely rare. They are mostly small, but sometimes attain a length of about 50 mm., when the terminal rhombohedron faces generally disappear.

(3.) Trigonal habit.

A very acute negative rhombohedron, terminated by striated faces of $\{110\}$ and characterised by the almost total absence of $\{100\}$. They are generally rendered nearly opaque by inclusions. The acute rhombohedron is inclined at an angle of 61° 30′ to the faces of $\{100\}$ as determined approximately by the hand goniometer. These crystals attain the same dimensions as (1).

(B.) Twin crystals.

(4.) Rectangular habit. Twin-plane (100).

These are formed by a pair of prisms intersecting nearly at right angles; the individuals are either transparent and belonging to habit (1) or opaque and belonging to habit (3). The latter are precisely similar to the well-known specimens from Wheal Wrey, Cornwall, with the exception that they have not the basal plane which is common upon Wheal Wrey crystals.

(5.) Butterfly habit. Twin-plane (100).

These crystals are identical in form with the well-known twins from Eyam in Derbyshire, but are transparent and attain larger dimensions than

the latter. The predominant forms are $\{10\bar{1}\}$ $\{2\bar{1}\bar{1}\}$, and uneven striated faces of the scalenohedron $\{20\bar{1}\}$; the peculiar form is produced by the exaggerated development of a pair of scalenohedron faces near the line of junction. Small faces of the forms $\{100\}$ $\{3\bar{1}\bar{1}\}$ are also found at the extremities of the twin. Sometimes one of the individuals is doubly terminated, in which case the portion which projects from the apex of the twin has the usual scalenohedral habit of the North of England calcites.

These twins sometimes attain a breadth of 80 mm.

(6.) Heart-shaped habit. Twin-plane (100).

These remarkable crystals owe their form to precisely the same mode of growth as those of the last habit; they differ from the latter in having a thickness along the twin-plane equal to more than half their breadth perpendicular to the same, and in their termination, which is formed by large striated faces of the rhombohedron $\{110\}$. Two adjacent faces of the usual scalenohedron $\{20\bar{1}\}$ are enlarged, but not nearly to the same extent as in habit (5); and more rarely the pair of prism faces $\{10\bar{1}\}$ which are perpendicular to the twin-plane are developed so as to give the twin a tabular appearance; in all cases the pair of rhombohedral surfaces $\{110\}$ which are adjacent in the two individuals are greatly enlarged in comparison with the remaining faces of the same form.

It is possible that union takes place in the interior of the twin along the plane of twinning, but on the surface the crystals overlap in an irregular manner; they are always developed on both sides of the twin-plane, *i.e.* so that the latter divides the twin symmetrically, but the individuals are sometimes doubly terminated and project to form a second heart-shaped twin at the other extremity.

The largest twin hitherto found is 135 mm. in breadth, 110 mm. in height, and has a thickness of 55 mm.; but the most perfect and limpid are the small crystals, which are sometimes not more than 20 mm. in breadth; the latter are identical in appearance with small twin-crystals formerly found in Derbyshire, which are accompanied by blende, galena, and nearly colourless fluor. In one specimen muddy brown inclusions are arranged in bands parallel to the prism face which is common to the two individuals and perpendicular to the twin-plane.

(7.) Heart-shaped habit. Twin-plane $(11\bar{1})$.

This is well known to be an extremely rare mode of twinning, and only two crystals twinned according to this law have been found among the Egremont calcites. The one which I have examined is a clear crystal, 40 mm. in length and 30 mm. in breadth, consisting of two prisms $\{2\bar{1}\bar{1}\}$ of

the usual habit, terminated by the striated faces {110}; there are also present faces of the usual forms {31$\bar{1}$}, {20$\bar{1}$}, {10$\bar{1}$}; the crystal is therefore precisely similar to those described under (6) with the exception that the principal axes of the two individuals are inclined at an angle of 53° 46′ instead of 90° 46′, while the pair of faces {110} which are perpendicular to the plane of the axes are opposite and not adjacent to one another. The angle between these faces can be accurately determined in spite of their nature, since the measurement is made along and not across the striations. The angle is

106° 17′ measured.
106° 16′ calculated.

Composition appears to take place parallel to the twin-plane in the interior, but on the surface the crystals overlap and have a zig-zag junction parallel to prism faces belonging alternately to the two individuals.

Here, as is the case with twins of habit (6), the crystal has been attached by its apex and is completely developed upon every side.

Crystals twinned (probably) according to this law have been described from Alten in Norway, and from Traversella, and there are also specimens in the British Museum from Alston, and from the Himalaya Mountains. In all these, however, the habit of the crystals is scalenohedral and not prismatic.

In Haidinger's Memoir on twin-crystals (*Edinburgh Journal of Science*, 1825, ii. plate iii.) are figures which have been copied into most text-books. Fig. 7 represents the butterfly habit No. (5), and Fig. 6 the heart-shaped habit No. (6), so accurately that it is unnecessary to repeat figures of this twin-law.

On the large Porphyritic Crystals of Felspar in certain Basalts of the Isle of Mull.

By Thomas H. Holland, A.N.S.S.

(Communicated by Prof. John W. Judd, F.R.S.)

[Read October 30th, 1888.]

In the basaltic lavas of Iceland certain porphyritic crystals of unusually large dimensions, occur embedded in the matrix of the rock, and from an early date have received the notice of writers on the geology of that island. Amongst these authors might be mentioned :—Professor Forchhammer,[1] Dr. F. A. Genth,[2] M. A. Damour,[3] Prof. Zirkel,[4] M. P. Schirlitz,[5] and M. R. Bréon.[6]

In 1885, Professor Judd,[7] in a paper on the Tertiary Basic Rocks of Scotland and Ireland, called attention to the porphyritic basalts on the north-east side of Mull, between Tobermory and Ardnacroish, in which he noticed these large crystals of felspar—"in some cases no less than two inches across."[8]

In consequence of the striking analogies which have been shown to exist between the basalts of Iceland and Mull, I have thought an examination of the porphyritic felspars occurring in the lavas of Mull would, for the sake of comparison with the Icelandic examples, be of some considerable interest.[9]

The specimens I have examined exhibit crystals measuring, in some cases, an inch or more across, varying from colourless to yellowish-green

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[1] *Journal für praktische Chemie.* Band III. 1843. p. 385.

[2] *Annalen der Chemie und Pharmacie.* B. LXVI. 1848. p. 13.

[3] *Bulletin de la Société Géologique de France.* Tome VII. s. II. 1850. p. 83.

[4] *Reise nach Island.* Appendix, p. 295.

[5] *Mineralogische und petrographische Mittheilungen.* B. IV. 1882. p. 414.

[6] *Notes pour servir à l'étude de la Géologie de l'Islande et des Iles Foeroe.* 1884. p. 17.

[7] The specimens employed for the purposes of the present paper have been kindly put into my hands by Professor Judd, to whom also for advice and direction I am most deeply indebted.

[8] Quart. Journ. Geol. Soc. Vol. XLII. (1886) p. 71.

[9] Dr. Geikie mentions, on the authority of Mr. Clough, of the Geological Survey of Scotland, the existence of very large crystals of felspar in some of the basic dykes of Argyllshire. *Trans. Royal Soc. Edin.* Vol. XXXV. Pt. 2. p. 37 (1888).

in colour, and, for the most part, transparent to translucent. They are frequently corroded by the magma, the basaltic material penetrating into the crystals being totally different in character to the general matrix of the rock; whilst the rock is a beautiful example of ophitic structure on a minute scale, the minerals entering into the composition of the filling material are most distinctly granulated, and, moreover, are accompanied by a larger amount of vitreous magma.

The size and easy cleavage of the crystals have facilitated their detachment in sufficient quantities for the investigation of both their physical and their chemical nature.

The specific gravity has been determined both in water and in absolute alcohol, giving 2·720 as the mean of results varying from 2·716 to 2·725. The angle between the two principal cleavages—parallel to the basal plane 001 (*oP*) and to the brachy-pinacoid 010 ($\infty \breve{P} \infty$) respectively—have been determined by the reflecting goniometer and found to be 93° 38′.[1] Sections parallel to the brachy-pinacoid have been examined, in the manner proposed by Max Schuster, between crossed nicols, and show an extinction angle of —30° 11′ as a mean of eight experiments, measured from the lines of basal cleavage. Similar sections made parallel to the basal plane were optically extinguished in the negative direction also, at an angle of 18° with the traces of cleavage planes parallel to 010 ($\infty \breve{P} \infty$). The plagioclastic twinning invariably follows the albite type and is very plainly exhibited, the crystal splitting with great facility along the *Gleitflächen*, exposing faces possessing a perfect vitreous lustre. The crystals frequently exhibit the phenomena of schillerization, the inclusions being arranged along parallel planes, the traces of which, on the face 010 ($\infty \breve{P} \infty$) included, in every case I have examined, an angle of 42° with the cracks of basal cleavage and 12° from the direction of optical extinction.

The chemical examination of these crystals has been made by the method of flame reactions, devised by Prof. J. Szabó, and by the ordinary methods of chemical analysis.

By Szabó's method I have obtained the following results :—

In the first experiment—heated for one minute in a Bunsen flame 5 millimetres above the burner—the coloration of the flame due to soda corresponded to degree 2 or from 2 to 3 in different trials, whilst there was no evidence whatever of the presence of potash. The angles

[1] This result is an average of six experiments which varied between 93° 30′ and 93° 40′, the wide difference being accounted for by the imperfect lustre of some of the faces of the cleavage plates, giving, thereby, only an imperfect reflection of the object employed.

and edges of the grain employed were each time slightly rounded. In the second experiment—heated in the *Schmelzraum* for one minute—the degree of soda was again slightly over 2, potash still being absent, whilst not only the points and edges but the faces of the grain began to fuse. By the addition of powdered gypsum and further heating in the *Schmelzraum* for two minutes—Experiment III. of Szabó—there was still no evidence exhibited of the presence of potash. The mineral, digested for 24 hours in hydrochloric acid, gave abundant evidence of the presence of calcium by the distinctly red coloration produced in the Bunsen flame. These results place the mineral, in these respects at least, somewhere near Bytownite, one of the types employed by Prof. Szabó, and in the scale of fusibility adopted by the same author it would take the degree 2 corresponding to about 5·5 on von Kobell's scale.

The chemical analysis has been performed by the ordinary method of decomposition with a mixture of the carbonates of soda and potash, a special decomposition for the alkalies being obtained by the method devised by Professor J. Lawrence Smith.

The following percentage composition has been obtained in this manner:—

Silica	50·80
Alumina, Ferric Oxide	31.54
Lime	12·83
Magnesia	tr.
Soda	3·96
Potash	tr.
Loss on ignition ...	0·52
	99·65

These results give an oxygen ratio for the Silica, Alumina, and the Oxides of Calcium and Alkalies of about 6 : 3 : 1.

M. R. Bréon,[1] working in the laboratory of M. Fouqué, has examined the properties of a felspar, occurring in a similar manner as large porphyritic crystals embedded in basalt on the cliffs of Stigahlid, and on the plateaux between Kerkjubol and Djupidalr in Iceland. These crystals, he says, sometimes reach a thickness of one centimetre, and a chemical analysis yielded him the following results :—

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[1] *Loc. cit.* p. 18 and Pl. II. fig. 2.

Silica	46·80
Alumina	33·50
Ferric Oxide	1·60
Lime	18·00
Magnesia	0·40
Soda	0·70
Potash	0·30
	101·30

These results give an oxygen ratio of 4·54 : 2·93 : 1, thus confirming the optical properties, which he found to agree with those of Anorthite. M. Bréon noticed the regular arrangement of inclusions[1] evidently the same as those to which I have already alluded—the phenomena to which the name of schillerization has been given.

Other authors, like Forchhammer, Genth, Damour, von Waltershausen, Zirkel and Schirlitz, have proved the existence, in the Icelandic basalts of felspars whose analyses undoubtedly refer them to Anorthite. Dr. Genth, for example, describes[2] what he thought to be a new mineral species under the name of Thjorsauite, occurring in the Hekla lavas near the banks of the Thjorsá.

He gives the following as the result of his analysis[3] :—

Silica	48·36
Alumina	30·59
Ferric Oxide	1·37
Magnesia	0·97
Manganese Oxide ...	tr.
Lime	17·16
Soda	1·13
Potash...	0·62
	100·20

Although Genth places this mineral as a form occupying a position in chemical nature between Scapolite, on the one hand, and Bytownite and

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[1] "On peut cependant remarquer dans les feldspaths des petites cavités rectangulaires alignées suivant les lignes de clivage et remplies de produits opaques dus à l'altération." *Loc. cit.* p. 18.

[2] *Untersuchung des Eruptionsproducte des Hekla. Loc. cit.* p. 18.

[3] This author gives a second analysis, in which he lost the alumina and neglected to estimate the soda and potash; but the results calculated differ but slightly from those quoted above.

Barsowite on the other, there is no doubt as to its position amongst the basic members of the plagioclastic series of felspars.

In the tables below I quote the analyses, which have justified the authors mentioned for referring the mineral to Anorthite :—

	I.	II.		III.	IV.
SiO_2 ...	45·65	45·14		45·97	47·63
Al_2O_3 ...	35·90	32·10		33·28	32·52
Fe_2O_3 ...	0·36	2·03		1·12	2·01
CaO ...	17·75	18·32		17·21	17·05
MgO ...	—	—		—	1·30
Na_2O ...	1·16	1·06		1·85	1·09
K_2O ...	—	0·22		—	0·29
Water ...	—	0·31	Pyroxene impurity	0·69	—
Mn_2O_3 ...	—	0·78		—	—
	100·82	99·96		100·12	101·89

I. Felspar in basalt from Priesterhof Halldorstadtr.[1]

II. Felspar in basalt from Hecla.[2]

III. Felspar in basalt from Thjorsá.[3]

IV. Felspar from Seljafjall.[4]

Although these analyses indicate a felspar far more basic in composition than that which I have examined, some of these authors have found similar large crystals, the chemical nature of which seem to be in close agreement with those from Mull. I quote these results below.

	I.	II.	III.	IV.
SiO_2 ...	51·61	52·52	52·17	50·80
Al_2O_3 ...	31·09	30·03	29·22	31·54
Fe_2O_3 ...	0·24	1·72	1·90	
CaO ..	13·01	12·58	13·11	12·83
MgO ...	—	0·19	—	tr.
Na_2O ...	4·11	4·51	3·40	3·96
K_2O ...	tr.	—	—	tr.
Loss on ignition	—	—	—	0·52
	100·06	101·55	99·80	99·65

[1] Shirlitz, *loc. cit.* p. 435.

[2] von Waltershausen. "Ueber die vulkanischen Gesteine in Sicilien und Island." Göttingen, 1853, p. 22.

[3] Damour, *loc. cit.* p. 87.

[4] Forchhammer, *loc. cit.* p. 388.

I. Felspar in dolerite from Hafnarfjördr.[1]

II. ,, in basalt from Faroe Isles.[2]

III. ,, in altered basalt from near Berufjord on the east Icelandic coast.[3]

IV. ,, from Mull (T.H.H.).

So far as the physical characters are given by these authors, they agree th the Mull specimens with a fair amount of constancy.

According to Tschermak's theory, that the forms included in the felsthic series of which Albite and Anorthite are limiting members, are morphous mixtures of these two species, the results I have obtained the examination both of the chemical and physical properties of this spar would give it a formula of Ab_1 An_3, a compound which theoretically ves an optical extinction angle of $-17° 40'$ and $-29° 38'$ on the basal ne and brachy-pinacoid respectively, closely agreeing, it will be seen, th the measurements above cited.

The similarity between this felspar and the theoretical compound Ab_1 $_3$ in physical properties is again confirmed in the chemical composition. Taking the formula of Albite as Na_2O, Al_2O_3, 6 SiO_2, we have an Oxygen tio of 1 : 3 : 12. Similarly considering Anorthite to be represented CaO, Al_2O_3, 2 SiO_2, we obtain a ratio of 1 : 3 : 4. If then, we have mixture of three parts of Anorthite (An_3) and one part of Albite (Ab_1) should have $(1 + 3 + 12) + (3 + 9 + 12)$—$(4 + 12 + 24)$ parts of ygen present, giving a ratio of 1 : 3 : 6, which result, is precisely ctical with that calculated from actual analysis.

[The work in connection with this paper has been carried out in the eological Research Laboratory of the Normal School of Science, South ensington.]

[1] Schirlitz, *loc. cit.* p. 435.

[2] Forchhammer, *loc. cit.* p. 387.

[3] Damour, *loc. cit.* p. 88.

A New Form of Microscope.

By Allan Dick.
(Communicated by the General Secretary.)

[Read October 13th, 1888.]

MANY years ago I requested Mr. Swift to make for me a first-rate Binocular Petrological Microscope. The centering of the stage by screws was, I suppose, as good as it could be made. I found it unsatisfactory when using high powers on small crystals. A centering nose-piece answered no better. Only by the simultaneous rotation of the polariser and analyser by hand, little by little, could I keep the interference figures of small crystals in the field of view, or feel certain that the figures had not left it during rotation owing to the excentricity of the centering. By small crystals I mean crystals under the $\frac{1}{1000}$ of an inch in diameter, and of such thickness as one finds them at the edges of petrological sections. Results obtained thereby were only slowly got, and always with some uncertainty. I tried the Nachet Microscope, but found it a cumbrous instrument. Latterly I connected the polariser and eye-piece analyser by a jointed rod, and got thereby excellent results, whilst I could still retain binocular vision for all but certain observations. I suggested to Mr. Swift that he should manufacture a more perfect Student's Microscope than any now obtainable: one which would suit alike the mineralogical, petrological, botanical or medical student. Having agreed upon the design of the instrument, I left to Mr. Swift the carrying out of the details, which he did in an ingenious manner and with excellent workmanship. When the microscope was finished I went over it carefully, and handed it to several friends interested in such matters for suggestions, all of which have been carried out. You see the result in a small microscope where there is little lumber and much capability of good work. Its interest to the Mineralogical Society lies in its adaptation to the study of the optical properties of minerals generally, and particularly to that of the thin plates of minerals seen in ordinary sections of rocks prepared for microscopical examination. For this purpose the analyser and polariser are connected together by toothed wheels. They can thus be turned together in any position relatively to one another—crossed, parallel or inclined—each nicol being so fitted that it can be set in any position. The wheels can be clamped in any position. The tube of the microscope is of the ordinary construction. Within the lower part of it is a sliding tube which carries a sliding plate. In the plate are three circular

openings, of which the central one is always open. In one of the other openings is fitted a Klein's plate; in the other a lens. The lens can be easily removed and another of different focus put in its place, according to the purpose for which it is to be used.

The lens of shorter focus brings interference figures into the eye-piece, where the *dispersion* may be studied, and also where the apparent angle in air of a biaxial crystal may be approximately measured, if the section is large enough to fill, or nearly fill, the field. For this and other purposes, a micrometer can be pushed into the eye-piece. In the instrument now described, with a B eye-piece 50° of the scale between the optic axes are equal to an apparent angle in air of 69½° for Muscovite. Exact measurement must, of course, be made by means of a stage goniometer.

The lens of longer focus is intended for use without the eye-piece, to enable the observer to see the interference figures (generally only the axial shadows being visible) by looking down the tube, when a $\frac{1}{10}$ or $\frac{1}{12}$ in. objective is used on very small crystals, in convergent light, between crossed nicols.

There is a weaker lens for the same purpose fitting into the top of the tube, which can be used with a $\frac{1}{4}$ or $\frac{1}{6}$ in. objective by those who, like myself, cannot see the figures without some aid.

The eye-piece, when in use, turns with the polarising apparatus. It contains the usual cross wires, and has an adjustment to enable an observer to focus the wires or the micrometer alluded to above. A quarter undulation plate of mica or a wedge of mica or quartz can be pushed through the eye-piece at 45° to the direction of the cross wires.

When the eye-piece is not in use its place can be taken by a fitting which carries the analyser and the weakest lens alluded to above. The condenser of the instrument consists of a lens screwed upon the top of the polariser, which slides up and down. The lens is suitable for all objectives up to the $\frac{1}{2}$ in. For higher powers and interference figures a small hemispherical lens is fitted into the stage and can be pushed into the axis of the instrument when required. The upper surface grazes the lower side of the glass slip carrying the object. The focusing is done by raising or lowering the polarizer carrying the aforesaid lens. This arrangement is found to work admirably.

The rotation of the eye-piece and polarising apparatus is measured on a circle graduated to degrees, but by using a pocket lens a good reading to half a degree can be obtained and a fair reading to quarter of a degree, nearer than which extinctions or angles cannot be measured even under the most favourable circumstances.

When the indicator is at zero on the graduated circle the cross wires are upright, and horizontal as the observer looks into the instrument. If the polariser is in its catch any suitable crystal with straight extinction will be at the maximum darkness when parallel to either cross wire. If Klein's plate be now pushed into the tube of the microscope and the analyser turned in its fitting till the crystal and the field are of one uniform warm blue tint it will be found that the nicols are accurately parallel. The nicols can then be turned parallel to one another by the toothed wheels. This is almost the only use I have found for the Klein's plate. I wished to put it aside altogether from a student's instrument, but Mr. Swift informed me that a microscope, to be used even occasionally for petrological investigations, cannot be sold without such a fitting, buyers requiring it, though they do not appear to make any use of it. It must be regarded as part of the little lumber which it seems this instrument must possess.

If the mineral with straight extinction is not lying parallel to either cross wire, it will be found that when the wheels are turned the crystal will be extinguished when either of the wires becomes parallel with it. If the mineral has an oblique extinction a reading of the circle must be made when one or other wire is parallel to one of the edges or lines of the crystal, and another reading after continuing the rotation till the maximum extinction is attained. The rotation is then continued through 45°, and a mica or quartz-wedge pushed through the slot in the eye-piece to ascertain the direction of the major or minor axis of elasticity and its inclination to the edge or line if desired.

It is with the use of convergent light for interference figures that the accuracy and simplicity of this instrument becomes apparent. No centering being required, it is evident that an interference figure once seen will remain in the centre of the field during the entire rotation. If it passes out of view it is on account of the nature of the figure. Even in the case of the smallest crystals, no doubt is ever left in the mind of the observer whether the figure may not have disappeared owing to imperfect centering.

I have placed on the table two typical sections. The one contains large and well-defined crystals of augite, olivine and felspar, from the Lion Haunch, near Edinburgh. It will be seen that by pushing any crystal towards the centre of the field till the angle to be measured touches the intersection of the cross wire, a reading of the angle is obtained. Pushing the crystal into the centre of the field and examining it by convergent light under a high power, it is easy to ascertain the direction of the line

joining its optic axes if they can be seen in the section. This is noted, and one of the cross wires brought parallel to it. A reading of the circle is then made and the rotation continued through 45 degrees. The high power is then replaced by a lower power, and the strongly converging upper lens of the condenser is pushed out so that the mineral may be examined in less strongly convergent light for the purpose of ascertaining in what direction compensation is obtained when the mica or quartz wedge is thrust through the eye-piece parallel or at right angles to the optic axial plane, inclined 45 degrees to the planes of the crossed nicols. By thus studying the emergence of a bisectrix it is seen whether it is positive or negative. The other section consists of a Scotch hornblende-schist. The greater part of the section consists of water-clear granules of quartz and felspar, containing amongst the mosaic a number of well-defined crystals of rutile, and an immense number of less well-defined crystals of some mineral showing very dark borders, due to the fact that its refractive index is much higher or much lower than that of the mosaic. All the grains, except the hornblende and some parts of the mosaic, are under the $\frac{1}{1000}$ of an inch, piled upon one another, for the section is a rather thick one except at the edges. In this section are two small grains, one of which shows the emergence of one optic axis of a felspar, whilst the other shows the cross of quartz cut nearly perpendicular to its principal axis. Close to it lies one of the still smaller grains of the more or less highly refractive crystals. It lies flat, gives straight extinction, and shows the nearly perpendicular emergence of an optic axis. I think the mineral is Epidote, but draw attention to it merely to show the ease with which interference figures can be studied. To a petrologist accustomed to a rotating stage and fixed cross wires, a familiar section looks strange when first looked at on a fixed stage with movable cross wires, but after a few hours' work with the instrument the feeling of strangeness passes, and that of the solid advantage of a perfect centering alone remains.

There is one fact which I should allude to in connection with the small interference figures seen on looking down the tube of the microscope. It is, that the spot of light at the back of the objective in which the figures are seen rotates slightly when the wheels are turned. This is due to its being seen by the extraordinary ray. It may be regarded as a blemish, but is of no practical importance.

Beneath the stage is a universal fitting, whereby any sub-stage arrangement may be applied for special studies. In this paper I have confined my description to those concerned in the application of the microscope to mineralogy and petrology.

Abstracts.

Dimorphism of Ullmannite.—F. Seeland (*Verhandlungen der geologischen Reichsanstalt*, 1887, p. 282) has examined the Ullmannite which was found at Hüttenberg in 1869, and finds that it is hemihedral, with inclined faces, but is identical in composition with the Ullmannite of Monte Narba in Sardinia, which was found by Klein to be hemihedral, with parallel faces. The specific gravity of the former is 6·62, and that of the latter 6·70-6 73. It follows, therefore, that we have here a case of dimorphism in the cubic system, unless, as seems improbable, both varieties are to be ascribed to the tetartohedral group; the variety from Hüttenberg therefore corresponds in form to Fahlerz, that from Monte Narba to Pyrites. H. A. M.

Microscopic Character of Sordawalite (Löwinson-Lessing in *Tsch. Mitth.* Vol. IX. (N.S.), p. 61; 1888).—This substance, once ranked as a mineral, is now well known to be a basic glassy rock. It forms a selvedge an inch or two wide to a dyke at Sordawala, Finland, on the north shore of Lake Ladoga. The main mass of the dyke, described as a "microlitic Vitrophyrite," appears to be a basalt with a glassy base. The selvedge shows four main types of structure, in order from the extreme margin inwards: (1) *hyaline*, (2) *globulitic*, (3) *spherulitic*, and (4) *microlitic*. A variety of the first is the so-called *granellitic*: the "granellites" differ from globulites in being mere "pigment-concretions," their main substance not distinct from the surrounding glass. Another variety is *micro-eutaxitic* or mosaic-like. Under the spherulitic type are included varieties with incipient and imperfect spherulites and bundles of diverging rays ("*radiolitic*" structure).

The author, in conclusion, designates the rock "Diabase-vitrophyrite" ("Diabase-pitchstone"). There seems to be no sufficient reason why this Sordawalite, although pre-Tertiary, should not be included under Tachylite. A. H.

The Occurrence of Boron-minerals (*Zeitschr. d. deutsch. geol. Gesellsch.*, Vol. XXXIX., p. 237; 1887).—A. von Groddeck, after describing the tourmaline-bearing copper ores of Chili, proceeds to give a general review of the mode of occurrence of minerals containing boron. He lays down the rule that the boro-silicates (Tourmaline, Axinite, Datolite, Danburite) and the anhydrous borates (Rhodizite, Jeremejewite, Eichwaldite, Sussexite, Ludwigite, Szajbelyite), with the exception of Boracite, occur exclusively as

uthigenic constituents in eruptive, Archæan, and metamorphic rocks. The tourmaline crystals in clays, slates, and sandstones are supposed by the author to be derived from crystalline schists, and not formed *in situ*, as believed by Wichmann and others. Excepting the boron-bearing micas (Sandberger), Tourmaline is the only boro-silicate which occurs with certainty as an original constituent of eruptive rocks: Axinite, Danburite, and Datolite are found in fissures and druses. The concentration of Tourmaline in the peripheral parts of the eruptive mass is well known, and has been referred to fumarole-action following the eruption: but the modern fumaroles of Vulcano, Tuscany, and California produce only Sassoline. The author considers that the boron in the case of the Tourmaline has been brought up by heated water.

Very different is the occurrence of the boro-silicates and anhydrous borates in the veins, fissures, and druses of eruptive Archæan and metamorphic rocks, and especially in veins of pegmatite and graphic granite. The four boro-silicates are met with mostly in the fissures and druses; Tourmaline chiefly in granite, gneiss, and mica-schist; the rare Danburite in granite; Axinite and Datolite chiefly in basic eruptive rocks, hornblende-schist, etc., where Tourmaline is not found. A connection between the minerals and the neighbouring rocks, as regards chemical composition, points to lateral secretion: the Chrome-tourmaline of the Urals occurs in fissures in chrome-iron-ore; the iron-bearing borate Ludwigite is associated with Magnetite; the Manganese-bearing Sussexite of New Jersey with Franklinite.

In normal fossiliferous sediments all the above minerals are wanting, and others containing boron appear in their place. In the gypsums, gypsum-marls, anhydrites, and potash-salts we find Boracite (Stassfurtite), Hydroboracite, Pinnoite, Lüneburgite, and Pandermite, all lime- and magnesia-borates which, with the exception of the first, contain water of crystallisation. Only in the gypsums and anhydrites of Hants county in Nova Scotia occur soda-bearing borates (hydrated), viz. Natroboro-calcite and the doubtful Cryptomerite, and Silicoborocalcite. Among the borates of superficial salt-lake and desert deposits are none containing magnesia, but only hydrous lime- and soda-borates (Borax, Hayesine, Colemanite, Natroborocalcite, and Franklandite). The origin of these may be explained by the known presence of boron in sea-water; but the restricted occurrence of anhydrous borates and of those containing magnesia remains a problem.

The author further discusses the occurrence of boron-minerals in ore deposits. Sassoline and Borax are found in the mercury ores now in

process of formation in California; but where boron-minerals are found in ordinary ore-deposits, they belong exclusively to the boro-silicates and anhydrous borates, and these are restricted to districts of eruptive, Archæan, and metamorphic rocks. Boron is not known in the stratified ore-deposits of sedimentary rocks. A. H.

Habit of Rock-forming Sphene. (A. C. Lane in *Tschermak's Mitth.*, N.S., Vol. IX. p. 207.)—The common forms are the following, the last three being subordinate:

		(*Miller.*)	
n	$\bar{1}23$	n	123
p	001	c	001
y	$\bar{1}01$	y	101
x	$10\bar{2}$	x	102
r	011	r	011
l	110	l	110

The author recognises two distinct types of Sphene in eruptive rocks; (1.) bounded by n, p, and y, seldom twinned, deeper coloured, occurring in rocks poor in alkalies and rich in Mg and Fe; (2.) bounded by r, n, and y, with p subordinate, often twinned, pale yellow, predominating in rocks rich in alkalies. A. H.

Baryto-celestine from Werfen, Salzburg. (E. Hatle and H. Tauss in *Tschermak's Mitth.*, N.S., Vol. IX. p. 227, 1888.)—This mineral, of a reddish-white to flesh-red colour, occurs with Wagnerite at Werfen. It has been mistaken successively for Gypsum and Barytes. Analysis shows it to be an isomorphous mixture of composition $4BaSO_4 + SrSO_4$, like the mineral from Görzing analysed by Rammelsberg. Its specific gravity is 4·17, hardness 3·5. A. H.

To distinguish Calcite, Dolomite, and Predazzite in Rocks.—Lemberg has recently given two micro-chemical methods for distinguishing these minerals, either in the powdered rock or a polished section. The former depends on the fact that Calcite precipitates ferric hydrate from a solution of ferric chloride much more rapidly than Dolomite does. (*Zeitschr. d. deutsch. geol. Gesellsch.*, Vol. XXXIX. p. 489, 1887.)—One part of the crystallised chloride is dissolved in ten of water, and filtered. This solution is allowed to act on the substance to be tested for a few seconds (always less than a minute), and then quickly removed by decanting. Calcite becomes coated with a film of ferric hydrate, while Dolomite produces but little effect. By treatment with ammonium sulphide the film of hydrate is converted into sulphide, and becomes black on the Calcite

while the Dolomite grains show only a pale green. The Brucite of the rock Predazzite takes a colour slightly darker than the Dolomite. To distinguish the three minerals, heat slightly after the treatment with $(NH_4)_2S$, and use AgNO solution: the Brucite becomes black, the Calcite brown, and the Dolomite colourless.

In the second method (*ibid.* Vol. XL. p. 357, 1888), Lemberg uses a solution of 4 parts Al_2Cl_6 in 60 parts of water, adds 6 parts of log-wood, and heats for 25 minutes, with stirring. The substance to be tested is treated with the solution for 5 to 10 minutes: Calcite becomes violet, while Dolomite and Brucite have but slight reaction. This method requires less careful adjustment of time than the former. A. H.

A new Hornblende Mineral, Riebeckite.—This mineral is first clearly described and named by Sauer (*Zeitschr. d. deutsch. geol. Gesellsch.*, Vol. XL., p. 138; 1888). It occupies the same place among the amphiboles as Aegirine does among the pyroxenes, and is quite distinct from Arfvedsonite.

	I.	II.	III.	IV.
SiO_2	43·85	49·04	52·22	50·01
Al_2O_3	4·45	1·80	0·64	—
Fe_2O_3	3·80	29·54	28·15	28·30
FeO	33·43	4·82	5·35	9·87
MnO	0·45	trace	0·54	0·63
MgO	0·81	trace	1·45	0·34
CaO	4·65	2·70	2·19	1·32
Na_2O	8·15	13·31	10·11	8·79
K_2O	1·06	trace	0·34	0·72
Loss	0·15	—	—	—
	100·80	101·21	100·99	99·98

I. True Arfvedsonite (*Lorenzen*), Greenland.
II. So-called Arfvedsonite (*Dölter*), Aegirine (*Lorenzen*), Greenland.
III. The same Aegirine (*Lorenzen*), Greenland.
IV. Riebeckite (*Sauer*), Socotra.

Rosenbusch finds that the axis of elasticity which makes an angle of only about 5° with c is not γ as in the other amphiboles, but α as in Aegirine. The absorption and pleochroism are very intense; α very deep blue; $\beta = b$ slightly less deep blue; γ green [or greenish brown]; angle between optic axes large. The mineral is, however, an amphibole, as is proved by the prismatic cleavage-angle of 123°50′ (mean of four measurements).

The mineral occurs in a granite from Socotra, both in large, black, ill-formed crystals, and in pale microlites. [It is curious that the same mineral, in these two habits, has been discovered independently by Professor Bonney and the present writer in the rock of Mynydd Mawr, near Llyn Cwellyn, Carnarvonshire. (*Min. Mag.*, Vol. VIII., p. 103; *Geol. Mag.*, 3rd Ser., Vol. V., pp. 221, 455; 1888).] A. H.

Foyaite from West Africa.—G. Gürich describes among other rocks a Foyaite which occurs in small patches in the Los Islands and Tumbo, another island nearer the mainland. (*Zeitschr. d. deutsch. geol. Gesellsch.*, Vol. XXXIX. p. 96, 1887.) The most abundant minerals of this rock appear to be Orthoclase, Elaeolite, Hornblende, and Aegirine: Plagioclase and Sodalite occur in smaller quantity, and crystals of Magnetite, while the occurrence of Lavenite and Astrophyllite is especially interesting.

The Aegirine forms radial-fibrous bundles and scattered columns. The pleochroism formula is, a, grass-green; β, olive-green; γ, pale reddish brown: absorption $a > \beta < \gamma$: extinction-angle up to 7° only. In the place of Aegirine there is sometimes a pleochroic green Augite.

The Lavenite is partly in irregular rounded or columnar grains, but partly also in crystals with definite faces. An orthopinacoidal cleavage is only occasionally marked. There is commonly twinning, sometimes lamellar, on the orthopinacoid. The columnar crystals are elongated parallel to the orthodiagonal. Pleochroism always evident; a, reddish yellow; β, pale wine-yellow; γ, almost colourless.

[Compare this rock with the Nepheline-Syenite of Brazil; see abstract of Machado's paper.] A. H.

Nepheline-Syenites, etc., from Brazil.—J. Machado[1] describes a number of eruptive rocks, mostly Nepheline-bearing, which break through the Biotite-gneisses in the provinces of Miñas Geraes and S. Paulo, Brazil. The Nepheline rocks show every gradation from coarse to fine-grained, and there are also compact and porphyritic types. The Nepheline (not Elaeolite) is often in good crystals, a fact interesting in connection with the age of the rocks, which are Silurian, if not older. They agree very closely with some Foyaites already described. The Nepheline is accompanied by Orthoclase (never Plagioclase) and green Aegirine: Sodalite is generally rare, but occurs in blue crystals in some of the rocks: Wollastonite is found as an original constituent in grains, crystals, and long

[1] *Tscherm. Mitth.*, N.S., Vol. IX. p. 318, 1888. *Cf.* Mr. O. A. Derby's paper in *Quart. Jour. Geol. Soc.*, Vol. XLIII. p. 457, 1887.

fibrous columns: also Lavenite, resembling Epidote in its optical characters.

A Quartz-Augite-diorite occurs at Monte-Santo. The Augite is accompanied by Hypersthene, and the Plagioclase partly replaced by Scapolite. An Olivine-diabase, with a small proportion of glassy base, occurs in several localities.

The following are selected from several analyses:—

	I.	II.	III.	IV.	V.	VI.
SiO_2 ...	51·60	49·32	52·75	56·30	53·10	65·20
TiO_2 ...	—	1·25	—	—	0·81	—
Al_2O_3 ...	1·92	4·88	22·55	24·14	22·50	16·25
Fe_2O_3 ...	26·29	16·28	3·65	1·99	5·10	5·45
FeO ...	4·20	5·65	—	—	—	—
MgO ...	1·15	4·28	0·15	0·13	0·15	1·87
CaO ...	4·25	9·39	1·85	0·69	2·15	7·55
Na_2O ...	8·89	8·68	8·10	9·28	8·49	2·87
K_2O ...	1·05	0·68	7·05	6·79	6·48	0·50
Loss ...	0·56	—	3·60	1·58	1·65	0·65
	99·91	100·41	99·70	100·90	100·43	100·34

I. Aegirine of Nepheline-Syenite, Barreiro, Brazil.

II. Aegirine of Phonolite of Elfdalen (*P. Mann*). [The Brazil Aegirine, however, compares much more closely with the Greenland Aegirine of Lorenzen and the Riebeckite of Sauer: see abstract of Sauer's paper.]

III. Nepheline-syenite, typical, of Brazil.

IV. Nepheline-syenite of Ditro (*Fellner*) for comparison.

V. Fine-grained Lavenite-bearing rock.

VI. Quartz-Augite-diorite of Monte-Santo. The high percentage of lime is due to the Scapolite. A. H.

NOTE.

On a peculiar variety of Hornblende from Mynydd Mawr, Carnarvonshire. By Prof. T. G. Bonney, D.Sc., LL.D., &c.

Since this paper was printed, a memoir by Prof. Sauer, on the peculiar blue hornblende from Socotra, has appeared (*Zeitsch. d. deutsch. geol. Gesellsch.* Vol. XL. p. 138). It is found on analysis to have more SiO_2, much more Fe_2O_3, and less FeO than Arfvedsonite, so that he proposes the separate name Riebeckite.

CONTENTS OF No. 38.

		PAGE
CHESTER.	A Mangano-magnesian Magnetite	125
HEDDLE.	On the Zeolites of Rye Water, Ayrshire	127
HEDDLE.	The Minerals of the Treshinish Islands	130
MORRISON.	Elaterite: a Mineral-Tar in Old Red Sandstone, Ross-shire	133
MACADAM.	Analyses of various Mineral Substances	135
FLETCHER.	The Renaissance of British Mineralogy	138
FLETCHER.	On the supposed fall of a Meteoric Stone at Chartres, Eure-et-Loir, France, in September 1810	146
MIERS.	Calcites from the neighbourhood of Egremont, Cumberland	149
HOLLAND.	On the large Porphyritic Crystals of Felspar in certain Basalts of the Isle of Mull	154
DICK.	A New Form of Microscope	160
	Abstracts	164

CONTENTS OF No. 37.

MIERS.	Contributions to the Study of Pyrargyrite and Proustite. With Analyses by G. T. Prior, B.A.	37
BONNEY.	On a peculiar variety of Hornblende from Mynydd Mawr, Carnarvonshire	103
BONNEY.	Note on a Picrite from the Liskeard District	108
KINCH.	On Dufrenite from Cornwall	112
TEALL.	Notes on some Minerals from the Lizard	116
LEWIS.	Obituary Notice of Gerhard vom Rath	121

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